

# Clinochlore $[\text{Mg}_3(\text{Mg}_2\text{Al})(\text{Si}_3\text{Al})\text{O}_{10}(\text{OH})_8, S5_5]$ Structure: A3B5C4D2\_mC112\_15\_a3ef\_5f\_4f\_2f-001

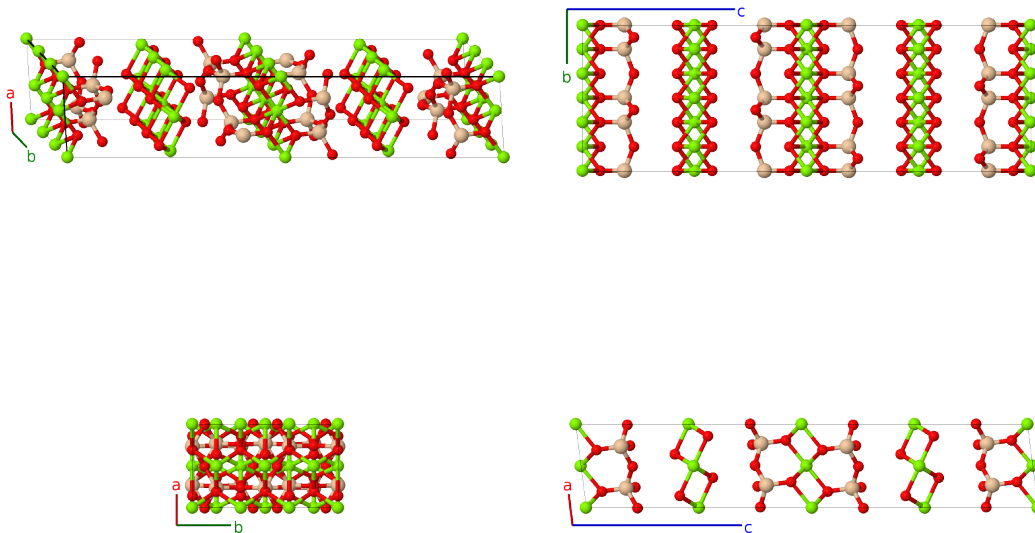
This structure originally had the label A3B5C4D2\_mC112\_15\_a3ef\_5f\_4f\_2f. Calls to that address will be redirected here.

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<https://aflow.org/p/RDRH>

[https://aflow.org/p/A3B5C4D2\\_mC112\\_15\\_a3ef\\_5f\\_4f\\_2f-001](https://aflow.org/p/A3B5C4D2_mC112_15_a3ef_5f_4f_2f-001)

● Mg  
● O  
● Si



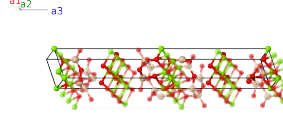
Prototype	$\text{Mg}_3\text{O}_5(\text{OH})_4\text{Si}_2$
AFLOW prototype label	A3B5C4D2_mC112_15_a3ef_5f_4f_2f-001
<i>Strukturbericht</i> designation	$S5_5$
Mineral name	clinochlore
ICSD	26850
Pearson symbol	mC112
Space group number	15
Space group symbol	$C2/c$
AFLOW prototype command	<pre>aflow --proto=A3B5C4D2_mC112_15_a3ef_5f_4f_2f-001       --params=a,b/a,c/a,beta,y2,y3,y4,x5,y5,z5,x6,y6,z6,x7,y7,z7,x8,y8,z8,x9,y9,z9,x10,       y10,z10,x11,y11,z11,x12,y12,z12,x13,y13,z13,x14,y14,z14,x15,y15,z15,x16,y16,z16</pre>

- We follow the interpretation of (McMurchy, 1934) as given by (Downs, 2003): We have labeled “Mg (4e)” are actually 2/3 magnesium and 1/3 aluminum, and the sites we have labeled “Si (8f)” are 3/4 silicon and 1/4 aluminum. This does not exactly match the ICSD entry.

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### Base-centered Monoclinic primitive vectors

$$\begin{aligned}\mathbf{a}_1 &= \frac{1}{2}a\hat{\mathbf{x}} - \frac{1}{2}b\hat{\mathbf{y}} \\ \mathbf{a}_2 &= \frac{1}{2}a\hat{\mathbf{x}} + \frac{1}{2}b\hat{\mathbf{y}} \\ \mathbf{a}_3 &= c\cos\beta\hat{\mathbf{x}} + c\sin\beta\hat{\mathbf{z}}\end{aligned}$$




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### Basis vectors

	Lattice coordinates		Cartesian coordinates	Wyckoff position	Atom type
$\mathbf{B}_1$	$0$	$=$	$0$	(4a)	Mg I
$\mathbf{B}_2$	$\frac{1}{2}\mathbf{a}_3$	$=$	$\frac{1}{2}c\cos\beta\hat{\mathbf{x}} + \frac{1}{2}c\sin\beta\hat{\mathbf{z}}$	(4a)	Mg I
$\mathbf{B}_3$	$-y_2\mathbf{a}_1 + y_2\mathbf{a}_2 + \frac{1}{4}\mathbf{a}_3$	$=$	$\frac{1}{4}c\cos\beta\hat{\mathbf{x}} + by_2\hat{\mathbf{y}} + \frac{1}{4}c\sin\beta\hat{\mathbf{z}}$	(4e)	Mg II
$\mathbf{B}_4$	$y_2\mathbf{a}_1 - y_2\mathbf{a}_2 + \frac{3}{4}\mathbf{a}_3$	$=$	$\frac{3}{4}c\cos\beta\hat{\mathbf{x}} - by_2\hat{\mathbf{y}} + \frac{3}{4}c\sin\beta\hat{\mathbf{z}}$	(4e)	Mg II
$\mathbf{B}_5$	$-y_3\mathbf{a}_1 + y_3\mathbf{a}_2 + \frac{1}{4}\mathbf{a}_3$	$=$	$\frac{1}{4}c\cos\beta\hat{\mathbf{x}} + by_3\hat{\mathbf{y}} + \frac{1}{4}c\sin\beta\hat{\mathbf{z}}$	(4e)	Mg III
$\mathbf{B}_6$	$y_3\mathbf{a}_1 - y_3\mathbf{a}_2 + \frac{3}{4}\mathbf{a}_3$	$=$	$\frac{3}{4}c\cos\beta\hat{\mathbf{x}} - by_3\hat{\mathbf{y}} + \frac{3}{4}c\sin\beta\hat{\mathbf{z}}$	(4e)	Mg III
$\mathbf{B}_7$	$-y_4\mathbf{a}_1 + y_4\mathbf{a}_2 + \frac{1}{4}\mathbf{a}_3$	$=$	$\frac{1}{4}c\cos\beta\hat{\mathbf{x}} + by_4\hat{\mathbf{y}} + \frac{1}{4}c\sin\beta\hat{\mathbf{z}}$	(4e)	Mg IV
$\mathbf{B}_8$	$y_4\mathbf{a}_1 - y_4\mathbf{a}_2 + \frac{3}{4}\mathbf{a}_3$	$=$	$\frac{3}{4}c\cos\beta\hat{\mathbf{x}} - by_4\hat{\mathbf{y}} + \frac{3}{4}c\sin\beta\hat{\mathbf{z}}$	(4e)	Mg IV
$\mathbf{B}_9$	$(x_5 - y_5)\mathbf{a}_1 + (x_5 + y_5)\mathbf{a}_2 + z_5\mathbf{a}_3$	$=$	$(ax_5 + cz_5\cos\beta)\hat{\mathbf{x}} + by_5\hat{\mathbf{y}} + cz_5\sin\beta\hat{\mathbf{z}}$	(8f)	Mg V
$\mathbf{B}_{10}$	$-(x_5 + y_5)\mathbf{a}_1 - (x_5 - y_5)\mathbf{a}_2 - (z_5 - \frac{1}{2})\mathbf{a}_3$	$=$	$-(ax_5 + c(z_5 - \frac{1}{2})\cos\beta)\hat{\mathbf{x}} + by_5\hat{\mathbf{y}} - c(z_5 - \frac{1}{2})\sin\beta\hat{\mathbf{z}}$	(8f)	Mg V
$\mathbf{B}_{11}$	$-(x_5 - y_5)\mathbf{a}_1 - (x_5 + y_5)\mathbf{a}_2 - z_5\mathbf{a}_3$	$=$	$-(ax_5 + cz_5\cos\beta)\hat{\mathbf{x}} - by_5\hat{\mathbf{y}} - cz_5\sin\beta\hat{\mathbf{z}}$	(8f)	Mg V
$\mathbf{B}_{12}$	$(x_5 + y_5)\mathbf{a}_1 + (x_5 - y_5)\mathbf{a}_2 + (z_5 + \frac{1}{2})\mathbf{a}_3$	$=$	$(ax_5 + c(z_5 + \frac{1}{2})\cos\beta)\hat{\mathbf{x}} - by_5\hat{\mathbf{y}} + c(z_5 + \frac{1}{2})\sin\beta\hat{\mathbf{z}}$	(8f)	Mg V
$\mathbf{B}_{13}$	$(x_6 - y_6)\mathbf{a}_1 + (x_6 + y_6)\mathbf{a}_2 + z_6\mathbf{a}_3$	$=$	$(ax_6 + cz_6\cos\beta)\hat{\mathbf{x}} + by_6\hat{\mathbf{y}} + cz_6\sin\beta\hat{\mathbf{z}}$	(8f)	O I
$\mathbf{B}_{14}$	$-(x_6 + y_6)\mathbf{a}_1 - (x_6 - y_6)\mathbf{a}_2 - (z_6 - \frac{1}{2})\mathbf{a}_3$	$=$	$-(ax_6 + c(z_6 - \frac{1}{2})\cos\beta)\hat{\mathbf{x}} + by_6\hat{\mathbf{y}} - c(z_6 - \frac{1}{2})\sin\beta\hat{\mathbf{z}}$	(8f)	O I
$\mathbf{B}_{15}$	$-(x_6 - y_6)\mathbf{a}_1 - (x_6 + y_6)\mathbf{a}_2 - z_6\mathbf{a}_3$	$=$	$-(ax_6 + cz_6\cos\beta)\hat{\mathbf{x}} - by_6\hat{\mathbf{y}} - cz_6\sin\beta\hat{\mathbf{z}}$	(8f)	O I
$\mathbf{B}_{16}$	$(x_6 + y_6)\mathbf{a}_1 + (x_6 - y_6)\mathbf{a}_2 + (z_6 + \frac{1}{2})\mathbf{a}_3$	$=$	$(ax_6 + c(z_6 + \frac{1}{2})\cos\beta)\hat{\mathbf{x}} - by_6\hat{\mathbf{y}} + c(z_6 + \frac{1}{2})\sin\beta\hat{\mathbf{z}}$	(8f)	O I
$\mathbf{B}_{17}$	$(x_7 - y_7)\mathbf{a}_1 + (x_7 + y_7)\mathbf{a}_2 + z_7\mathbf{a}_3$	$=$	$(ax_7 + cz_7\cos\beta)\hat{\mathbf{x}} + by_7\hat{\mathbf{y}} + cz_7\sin\beta\hat{\mathbf{z}}$	(8f)	O II
$\mathbf{B}_{18}$	$-(x_7 + y_7)\mathbf{a}_1 - (x_7 - y_7)\mathbf{a}_2 - (z_7 - \frac{1}{2})\mathbf{a}_3$	$=$	$-(ax_7 + c(z_7 - \frac{1}{2})\cos\beta)\hat{\mathbf{x}} + by_7\hat{\mathbf{y}} - c(z_7 - \frac{1}{2})\sin\beta\hat{\mathbf{z}}$	(8f)	O II
$\mathbf{B}_{19}$	$-(x_7 - y_7)\mathbf{a}_1 - (x_7 + y_7)\mathbf{a}_2 - z_7\mathbf{a}_3$	$=$	$-(ax_7 + cz_7\cos\beta)\hat{\mathbf{x}} - by_7\hat{\mathbf{y}} - cz_7\sin\beta\hat{\mathbf{z}}$	(8f)	O II
$\mathbf{B}_{20}$	$(x_7 + y_7)\mathbf{a}_1 + (x_7 - y_7)\mathbf{a}_2 + (z_7 + \frac{1}{2})\mathbf{a}_3$	$=$	$(ax_7 + c(z_7 + \frac{1}{2})\cos\beta)\hat{\mathbf{x}} - by_7\hat{\mathbf{y}} + c(z_7 + \frac{1}{2})\sin\beta\hat{\mathbf{z}}$	(8f)	O II

$$\begin{aligned}
\mathbf{B}_{21} &= (x_8 - y_8) \mathbf{a}_1 + (x_8 + y_8) \mathbf{a}_2 + z_8 \mathbf{a}_3 &= (ax_8 + cz_8 \cos \beta) \hat{\mathbf{x}} + by_8 \hat{\mathbf{y}} + cz_8 \sin \beta \hat{\mathbf{z}} & (8f) & \text{O III} \\
\mathbf{B}_{22} &= -(x_8 + y_8) \mathbf{a}_1 - (x_8 - y_8) \mathbf{a}_2 - (z_8 - \frac{1}{2}) \mathbf{a}_3 &= -(ax_8 + c(z_8 - \frac{1}{2}) \cos \beta) \hat{\mathbf{x}} + by_8 \hat{\mathbf{y}} - c(z_8 - \frac{1}{2}) \sin \beta \hat{\mathbf{z}} & (8f) & \text{O III} \\
\mathbf{B}_{23} &= -(x_8 - y_8) \mathbf{a}_1 - (x_8 + y_8) \mathbf{a}_2 - z_8 \mathbf{a}_3 &= -(ax_8 + cz_8 \cos \beta) \hat{\mathbf{x}} - by_8 \hat{\mathbf{y}} - cz_8 \sin \beta \hat{\mathbf{z}} & (8f) & \text{O III} \\
\mathbf{B}_{24} &= (x_8 + y_8) \mathbf{a}_1 + (x_8 - y_8) \mathbf{a}_2 + (z_8 + \frac{1}{2}) \mathbf{a}_3 &= (ax_8 + c(z_8 + \frac{1}{2}) \cos \beta) \hat{\mathbf{x}} - by_8 \hat{\mathbf{y}} + c(z_8 + \frac{1}{2}) \sin \beta \hat{\mathbf{z}} & (8f) & \text{O III} \\
\mathbf{B}_{25} &= (x_9 - y_9) \mathbf{a}_1 + (x_9 + y_9) \mathbf{a}_2 + z_9 \mathbf{a}_3 &= (ax_9 + cz_9 \cos \beta) \hat{\mathbf{x}} + by_9 \hat{\mathbf{y}} + cz_9 \sin \beta \hat{\mathbf{z}} & (8f) & \text{O IV} \\
\mathbf{B}_{26} &= -(x_9 + y_9) \mathbf{a}_1 - (x_9 - y_9) \mathbf{a}_2 - (z_9 - \frac{1}{2}) \mathbf{a}_3 &= -(ax_9 + c(z_9 - \frac{1}{2}) \cos \beta) \hat{\mathbf{x}} + by_9 \hat{\mathbf{y}} - c(z_9 - \frac{1}{2}) \sin \beta \hat{\mathbf{z}} & (8f) & \text{O IV} \\
\mathbf{B}_{27} &= -(x_9 - y_9) \mathbf{a}_1 - (x_9 + y_9) \mathbf{a}_2 - z_9 \mathbf{a}_3 &= -(ax_9 + cz_9 \cos \beta) \hat{\mathbf{x}} - by_9 \hat{\mathbf{y}} - cz_9 \sin \beta \hat{\mathbf{z}} & (8f) & \text{O IV} \\
\mathbf{B}_{28} &= (x_9 + y_9) \mathbf{a}_1 + (x_9 - y_9) \mathbf{a}_2 + (z_9 + \frac{1}{2}) \mathbf{a}_3 &= (ax_9 + c(z_9 + \frac{1}{2}) \cos \beta) \hat{\mathbf{x}} - by_9 \hat{\mathbf{y}} + c(z_9 + \frac{1}{2}) \sin \beta \hat{\mathbf{z}} & (8f) & \text{O IV} \\
\mathbf{B}_{29} &= (x_{10} - y_{10}) \mathbf{a}_1 + (x_{10} + y_{10}) \mathbf{a}_2 + z_{10} \mathbf{a}_3 &= (ax_{10} + cz_{10} \cos \beta) \hat{\mathbf{x}} + by_{10} \hat{\mathbf{y}} + cz_{10} \sin \beta \hat{\mathbf{z}} & (8f) & \text{O V} \\
\mathbf{B}_{30} &= -(x_{10} + y_{10}) \mathbf{a}_1 - (x_{10} - y_{10}) \mathbf{a}_2 - (z_{10} - \frac{1}{2}) \mathbf{a}_3 &= -(ax_{10} + c(z_{10} - \frac{1}{2}) \cos \beta) \hat{\mathbf{x}} + by_{10} \hat{\mathbf{y}} - c(z_{10} - \frac{1}{2}) \sin \beta \hat{\mathbf{z}} & (8f) & \text{O V} \\
\mathbf{B}_{31} &= -(x_{10} - y_{10}) \mathbf{a}_1 - (x_{10} + y_{10}) \mathbf{a}_2 - z_{10} \mathbf{a}_3 &= -(ax_{10} + cz_{10} \cos \beta) \hat{\mathbf{x}} - by_{10} \hat{\mathbf{y}} - cz_{10} \sin \beta \hat{\mathbf{z}} & (8f) & \text{O V} \\
\mathbf{B}_{32} &= (x_{10} + y_{10}) \mathbf{a}_1 + (x_{10} - y_{10}) \mathbf{a}_2 + (z_{10} + \frac{1}{2}) \mathbf{a}_3 &= (ax_{10} + c(z_{10} + \frac{1}{2}) \cos \beta) \hat{\mathbf{x}} - by_{10} \hat{\mathbf{y}} + c(z_{10} + \frac{1}{2}) \sin \beta \hat{\mathbf{z}} & (8f) & \text{O V} \\
\mathbf{B}_{33} &= (x_{11} - y_{11}) \mathbf{a}_1 + (x_{11} + y_{11}) \mathbf{a}_2 + z_{11} \mathbf{a}_3 &= (ax_{11} + cz_{11} \cos \beta) \hat{\mathbf{x}} + by_{11} \hat{\mathbf{y}} + cz_{11} \sin \beta \hat{\mathbf{z}} & (8f) & \text{OH I} \\
\mathbf{B}_{34} &= -(x_{11} + y_{11}) \mathbf{a}_1 - (x_{11} - y_{11}) \mathbf{a}_2 - (z_{11} - \frac{1}{2}) \mathbf{a}_3 &= -(ax_{11} + c(z_{11} - \frac{1}{2}) \cos \beta) \hat{\mathbf{x}} + by_{11} \hat{\mathbf{y}} - c(z_{11} - \frac{1}{2}) \sin \beta \hat{\mathbf{z}} & (8f) & \text{OH I} \\
\mathbf{B}_{35} &= -(x_{11} - y_{11}) \mathbf{a}_1 - (x_{11} + y_{11}) \mathbf{a}_2 - z_{11} \mathbf{a}_3 &= -(ax_{11} + cz_{11} \cos \beta) \hat{\mathbf{x}} - by_{11} \hat{\mathbf{y}} - cz_{11} \sin \beta \hat{\mathbf{z}} & (8f) & \text{OH I} \\
\mathbf{B}_{36} &= (x_{11} + y_{11}) \mathbf{a}_1 + (x_{11} - y_{11}) \mathbf{a}_2 + (z_{11} + \frac{1}{2}) \mathbf{a}_3 &= (ax_{11} + c(z_{11} + \frac{1}{2}) \cos \beta) \hat{\mathbf{x}} - by_{11} \hat{\mathbf{y}} + c(z_{11} + \frac{1}{2}) \sin \beta \hat{\mathbf{z}} & (8f) & \text{OH I} \\
\mathbf{B}_{37} &= (x_{12} - y_{12}) \mathbf{a}_1 + (x_{12} + y_{12}) \mathbf{a}_2 + z_{12} \mathbf{a}_3 &= (ax_{12} + cz_{12} \cos \beta) \hat{\mathbf{x}} + by_{12} \hat{\mathbf{y}} + cz_{12} \sin \beta \hat{\mathbf{z}} & (8f) & \text{OH II} \\
\mathbf{B}_{38} &= -(x_{12} + y_{12}) \mathbf{a}_1 - (x_{12} - y_{12}) \mathbf{a}_2 - (z_{12} - \frac{1}{2}) \mathbf{a}_3 &= -(ax_{12} + c(z_{12} - \frac{1}{2}) \cos \beta) \hat{\mathbf{x}} + by_{12} \hat{\mathbf{y}} - c(z_{12} - \frac{1}{2}) \sin \beta \hat{\mathbf{z}} & (8f) & \text{OH II} \\
\mathbf{B}_{39} &= -(x_{12} - y_{12}) \mathbf{a}_1 - (x_{12} + y_{12}) \mathbf{a}_2 - z_{12} \mathbf{a}_3 &= -(ax_{12} + cz_{12} \cos \beta) \hat{\mathbf{x}} - by_{12} \hat{\mathbf{y}} - cz_{12} \sin \beta \hat{\mathbf{z}} & (8f) & \text{OH II} \\
\mathbf{B}_{40} &= (x_{12} + y_{12}) \mathbf{a}_1 + (x_{12} - y_{12}) \mathbf{a}_2 + (z_{12} + \frac{1}{2}) \mathbf{a}_3 &= (ax_{12} + c(z_{12} + \frac{1}{2}) \cos \beta) \hat{\mathbf{x}} - by_{12} \hat{\mathbf{y}} + c(z_{12} + \frac{1}{2}) \sin \beta \hat{\mathbf{z}} & (8f) & \text{OH II} \\
\mathbf{B}_{41} &= (x_{13} - y_{13}) \mathbf{a}_1 + (x_{13} + y_{13}) \mathbf{a}_2 + z_{13} \mathbf{a}_3 &= (ax_{13} + cz_{13} \cos \beta) \hat{\mathbf{x}} + by_{13} \hat{\mathbf{y}} + cz_{13} \sin \beta \hat{\mathbf{z}} & (8f) & \text{OH III} \\
\mathbf{B}_{42} &= -(x_{13} + y_{13}) \mathbf{a}_1 - (x_{13} - y_{13}) \mathbf{a}_2 - (z_{13} - \frac{1}{2}) \mathbf{a}_3 &= -(ax_{13} + c(z_{13} - \frac{1}{2}) \cos \beta) \hat{\mathbf{x}} + by_{13} \hat{\mathbf{y}} - c(z_{13} - \frac{1}{2}) \sin \beta \hat{\mathbf{z}} & (8f) & \text{OH III} \\
\mathbf{B}_{43} &= -(x_{13} - y_{13}) \mathbf{a}_1 - (x_{13} + y_{13}) \mathbf{a}_2 - z_{13} \mathbf{a}_3 &= -(ax_{13} + cz_{13} \cos \beta) \hat{\mathbf{x}} - by_{13} \hat{\mathbf{y}} - cz_{13} \sin \beta \hat{\mathbf{z}} & (8f) & \text{OH III}
\end{aligned}$$

$$\begin{aligned}
\mathbf{B}_{44} &= \begin{pmatrix} (x_{13} + y_{13}) \mathbf{a}_1 + \\ (x_{13} - y_{13}) \mathbf{a}_2 + (z_{13} + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = \begin{pmatrix} (ax_{13} + c(z_{13} + \frac{1}{2}) \cos \beta) \hat{\mathbf{x}} - by_{13} \hat{\mathbf{y}} + \\ c(z_{13} + \frac{1}{2}) \sin \beta \hat{\mathbf{z}} \end{pmatrix} & (8f) & \text{OH III} \\
\mathbf{B}_{45} &= \begin{pmatrix} (x_{14} - y_{14}) \mathbf{a}_1 + \\ (x_{14} + y_{14}) \mathbf{a}_2 + z_{14} \mathbf{a}_3 \end{pmatrix} = \begin{pmatrix} (ax_{14} + cz_{14} \cos \beta) \hat{\mathbf{x}} + by_{14} \hat{\mathbf{y}} + cz_{14} \sin \beta \hat{\mathbf{z}} \end{pmatrix} & (8f) & \text{OH IV} \\
\mathbf{B}_{46} &= \begin{pmatrix} -(x_{14} + y_{14}) \mathbf{a}_1 - \\ (x_{14} - y_{14}) \mathbf{a}_2 - (z_{14} - \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = \begin{pmatrix} -(ax_{14} + c(z_{14} - \frac{1}{2}) \cos \beta) \hat{\mathbf{x}} + by_{14} \hat{\mathbf{y}} - \\ c(z_{14} - \frac{1}{2}) \sin \beta \hat{\mathbf{z}} \end{pmatrix} & (8f) & \text{OH IV} \\
\mathbf{B}_{47} &= \begin{pmatrix} -(x_{14} - y_{14}) \mathbf{a}_1 - \\ (x_{14} + y_{14}) \mathbf{a}_2 - z_{14} \mathbf{a}_3 \end{pmatrix} = \begin{pmatrix} -(ax_{14} + cz_{14} \cos \beta) \hat{\mathbf{x}} - by_{14} \hat{\mathbf{y}} - \\ cz_{14} \sin \beta \hat{\mathbf{z}} \end{pmatrix} & (8f) & \text{OH IV} \\
\mathbf{B}_{48} &= \begin{pmatrix} (x_{14} + y_{14}) \mathbf{a}_1 + \\ (x_{14} - y_{14}) \mathbf{a}_2 + (z_{14} + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = \begin{pmatrix} (ax_{14} + c(z_{14} + \frac{1}{2}) \cos \beta) \hat{\mathbf{x}} - by_{14} \hat{\mathbf{y}} + \\ c(z_{14} + \frac{1}{2}) \sin \beta \hat{\mathbf{z}} \end{pmatrix} & (8f) & \text{OH IV} \\
\mathbf{B}_{49} &= \begin{pmatrix} (x_{15} - y_{15}) \mathbf{a}_1 + \\ (x_{15} + y_{15}) \mathbf{a}_2 + z_{15} \mathbf{a}_3 \end{pmatrix} = \begin{pmatrix} (ax_{15} + cz_{15} \cos \beta) \hat{\mathbf{x}} + by_{15} \hat{\mathbf{y}} + cz_{15} \sin \beta \hat{\mathbf{z}} \end{pmatrix} & (8f) & \text{Si I} \\
\mathbf{B}_{50} &= \begin{pmatrix} -(x_{15} + y_{15}) \mathbf{a}_1 - \\ (x_{15} - y_{15}) \mathbf{a}_2 - (z_{15} - \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = \begin{pmatrix} -(ax_{15} + c(z_{15} - \frac{1}{2}) \cos \beta) \hat{\mathbf{x}} + by_{15} \hat{\mathbf{y}} - \\ c(z_{15} - \frac{1}{2}) \sin \beta \hat{\mathbf{z}} \end{pmatrix} & (8f) & \text{Si I} \\
\mathbf{B}_{51} &= \begin{pmatrix} -(x_{15} - y_{15}) \mathbf{a}_1 - \\ (x_{15} + y_{15}) \mathbf{a}_2 - z_{15} \mathbf{a}_3 \end{pmatrix} = \begin{pmatrix} -(ax_{15} + cz_{15} \cos \beta) \hat{\mathbf{x}} - by_{15} \hat{\mathbf{y}} - \\ cz_{15} \sin \beta \hat{\mathbf{z}} \end{pmatrix} & (8f) & \text{Si I} \\
\mathbf{B}_{52} &= \begin{pmatrix} (x_{15} + y_{15}) \mathbf{a}_1 + \\ (x_{15} - y_{15}) \mathbf{a}_2 + (z_{15} + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = \begin{pmatrix} (ax_{15} + c(z_{15} + \frac{1}{2}) \cos \beta) \hat{\mathbf{x}} - by_{15} \hat{\mathbf{y}} + \\ c(z_{15} + \frac{1}{2}) \sin \beta \hat{\mathbf{z}} \end{pmatrix} & (8f) & \text{Si I} \\
\mathbf{B}_{53} &= \begin{pmatrix} (x_{16} - y_{16}) \mathbf{a}_1 + \\ (x_{16} + y_{16}) \mathbf{a}_2 + z_{16} \mathbf{a}_3 \end{pmatrix} = \begin{pmatrix} (ax_{16} + cz_{16} \cos \beta) \hat{\mathbf{x}} + by_{16} \hat{\mathbf{y}} + cz_{16} \sin \beta \hat{\mathbf{z}} \end{pmatrix} & (8f) & \text{Si II} \\
\mathbf{B}_{54} &= \begin{pmatrix} -(x_{16} + y_{16}) \mathbf{a}_1 - \\ (x_{16} - y_{16}) \mathbf{a}_2 - (z_{16} - \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = \begin{pmatrix} -(ax_{16} + c(z_{16} - \frac{1}{2}) \cos \beta) \hat{\mathbf{x}} + by_{16} \hat{\mathbf{y}} - \\ c(z_{16} - \frac{1}{2}) \sin \beta \hat{\mathbf{z}} \end{pmatrix} & (8f) & \text{Si II} \\
\mathbf{B}_{55} &= \begin{pmatrix} -(x_{16} - y_{16}) \mathbf{a}_1 - \\ (x_{16} + y_{16}) \mathbf{a}_2 - z_{16} \mathbf{a}_3 \end{pmatrix} = \begin{pmatrix} -(ax_{16} + cz_{16} \cos \beta) \hat{\mathbf{x}} - by_{16} \hat{\mathbf{y}} - \\ cz_{16} \sin \beta \hat{\mathbf{z}} \end{pmatrix} & (8f) & \text{Si II} \\
\mathbf{B}_{56} &= \begin{pmatrix} (x_{16} + y_{16}) \mathbf{a}_1 + \\ (x_{16} - y_{16}) \mathbf{a}_2 + (z_{16} + \frac{1}{2}) \mathbf{a}_3 \end{pmatrix} = \begin{pmatrix} (ax_{16} + c(z_{16} + \frac{1}{2}) \cos \beta) \hat{\mathbf{x}} - by_{16} \hat{\mathbf{y}} + \\ c(z_{16} + \frac{1}{2}) \sin \beta \hat{\mathbf{z}} \end{pmatrix} & (8f) & \text{Si II}
\end{aligned}$$

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